THAT WHICH IS CLAIMED

1. An optoelectronic device, comprising:

a flexible substrate having a first surface; and

an optical interconnect formed on the first surface of the flexible substrate comprising a sol-gel based material.

2. The optoelectronic device of Claim 1, wherein the flexible substrate comprises a polymeric substrate.

3. The optoelectronic device of Claim 1, wherein the sol-gel based material comprises pre-hydrolyzed silica sol-gel.

4. The optoelectronic device of Claim 1, wherein the sol-gel based material is formulated, post pre-hydrolyzation, without the addition of water.

5. The optoelectronic device of Claim 1, wherein the sol-gel based material is formulated, post pre-hydrolyzation, without the addition of alcohol.

6. The optoelectronic device of Claim 1, wherein the optical interconnect is formed at processing temperatures below the glass transition temperature of the sol-gel.

7. The optoelectronic device of Claim 1, wherein the optical interconnect includes an active region and wherein the optoelectronic device further comprises at least one optical source for optically pumping the active region.

8. The optoelectronic device of Claim 7, wherein the active region comprises rare earth ions.

9. The optoelectronic device of Claim 8, wherein the rare earth ions have transition lines in the about 0.2 micron to about 3.0 micron spectrum when illuminated by said at least one optical source.

10. The optoelectronic device of Claim 8, wherein the rare earth ions have transition lines in the about 1.5 micron region when illuminated by said at least one optical source.

11. The optoelectronic device of Claim 8, wherein the rare earth ions comprise a rare earth ion chosen from the group consisting of erbium, ytterbium and neodymium ions.

12. The optoelectronic device of Claim 8, wherein the rare earth ions further comprise erbium ions and ytterbium ions.

13. The optoelectronic device of Claim 1, wherein the sol-gel based material further comprises at least one electro-optic organic component.

14. The optoelectronic device of Claim 7, wherein the active region is optically side-pumped.

15. The optoelectronic device of Claim 1, wherein the optical interconnect further comprises grating structures formed on the optical interconnect.

16. The optoelectronic device of Claim 15, wherein the grating structures have a fixed periodicity.

17. The optoelectronic device of Claim 15, wherein the grating structures have a chirped periodicity.

18. The optoelectronic device of Claim 1, wherein the optical interconnect further comprises prism structures formed on the optical interconnect.

19. An array of optical interconnects, comprising:

a flexible substrate having a first surface; and

a plurality of optical interconnects disposed in a predetermined pattern on the first surface of the flexible substrate, the optical interconnects comprising a sol-gel based material.

20. The array of Claim 19, wherein the flexible substrate comprises a polymeric substrate.

21. The array of Claim 19, wherein the sol-gel based material comprises pre-hydrolyzed silica sol-gel.

22. The array of Claim 19, wherein the sol-gel based material is formulated, post pre-hydrolyzation, without the addition of water.

23. The array of Claim 19, wherein the sol-gel based material is formulated, post pre-hydrolyzation, without the addition of alcohol.

24. The array of Claim 19, wherein the plurality of optical interconnects are formed at processing temperatures below the glass transition temperature of the sol-gel.

25. The array of Claim 19, wherein the plurality of optoelectronic interconnects are point-to-point waveguides.

26. The array of Claim 19, wherein the plurality of optoelectronic interconnects are point-to-multipoint waveguides.

27. The array of Claim 19, wherein the plurality of optoelectronic interconnects are selected from the group consisting of point-to-point waveguides and point-to-multipoint waveguides.

28. The array of Claim 19, wherein the predetermined pattern for disposing the plurality of optical interconnects is generally side by side on the first surface of the flexible substrate.

29. The array of Claim 19, wherein the plurality of optical interconnects include active regions and wherein the optoelectronic device further comprises at least one optical source for optically pumping the active regions.

30. The array of Claim 29, wherein the active regions comprise rare earth ions.

31. The array of Claim 29, wherein the active region is optically side-pumped with the at least one optical source.

32. An optoelectronic system, comprising:

a substrate having a first surface;

an optical interconnect formed on the first surface of the substrate comprising sol-gel based material and having an active region; and

at least one optical source in optical communication with the optical interconnect that is used to pump the active region of the optical interconnect.

33. The optoelectronic system of Claim 32, wherein the at least one optical source comprises sol-gel based material.

34. The optoelectronic system of Claim 32, wherein the at least one optical source comprises at least one vertical cavity surface emitting laser (VCSEL).

35. The optoelectronic system of Claim 32, wherein the at least one optical source comprises at least one fiber laser.

36. The optoelectronic system of Claim 32, wherein the at least one optical source comprises at least one waveguide laser.

37. The optoelectronic system of Claim 32, wherein the at least one optical source comprises at least one semiconductor laser.

38. The optoelectronic system of Claim 32, wherein the at least one optical source is used to side-pump the active region of the optical interconnect.

39. The optoelectronic system of Claim 32, wherein the least one optical source is used to end-pump the active region of the optical interconnect.

40. The optoelectronic system of Claim 32, wherein the substrate comprises a polymeric substrate.

41. The optoelectronic system of Claim 32, wherein the sol-gel based material comprises pre-hydrolyzed silica sol-gel.

42. The optoelectronic system of Claim 32, wherein the active region of the optical interconnect comprises rare earth ions.

43. The optoelectronic system of Claim 32, wherein the sol-gel based material further comprises at least one electro-optic organic component.

44. The optoelectronic system of Claim 32, further comprising an optical detector that is in optical communication with the optical interconnect for detecting an optical signal within the optical interconnect.

45. The optoelectronic system of Claim 43, wherein the optical detector comprises a sol-gel based material.

46. An optoelectronic device comprising:

a flexible substrate having a first surface;

a first cladding layer disposed on the first surface of the flexible substrate, the first cladding layer comprising a first sol-gel based material;

a core layer disposed on the first cladding layer, the core layer comprising a second sol-gel based material and having a higher refractive index than the first cladding layer; and

a second cladding layer disposed on the core layer and the first cladding layer, the second cladding layer comprising the first sol-gel based material.

47. The optoelectronic device of Claim 46, further comprising a polymer layer disposed on the first surface of the flexible substrate and the second cladding layer.

48. The optoelectronic device of Claim 46, wherein the first and second cladding layer is formed at process temperatures below the glass transition temperature of the first sol-gel based material and the core layer is formed at process temperatures below the glass transition temperature of the second sol-gel based material.

49. An optoelectronic device, comprising:

a flexible substrate having a first surface; and

a sol-gel based layer disposed on the first surface of the flexible substrate having a core region of a higher refractive index and a cladding region adjacent to the core region of a lower refractive index.

50. The optoelectronic device of Claim 49, further comprising a polymer layer disposed on the first surface of the flexible substrate and the sol-gel based layer.

51. The optoelectronic device of Claim 49, wherein the sol-gel based layer is formed at process temperatures below the glass transition temperature of the first sol-gel based material.

52. An optoelectronic device, comprising:

a substrate having a first surface;

a first optical interconnect disposed on the first surface of the substrate comprising a sol-gel based material; and

a second optical interconnect formed on the first surface of the substrate generally parallel to the first optical interconnect, the second optical interconnect comprising a sol-gel based material;

wherein, the first and second optical interconnects are positioned in close proximity to one another to define a first coupling region which facilitates optical coupling between the first and second optical interconnects.

53. The optoelectronic device of Claim 52, wherein the first and second optical interconnects are positioned in a Michelson interferometer configuration.

54. The optoelectronic device of Claim 53, wherein the optoelectronic device provides for an optical sensor.

55. The optoelectronic device of Claim 52, wherein the first optical interconnect comprises an arm and a grating structure formed on the arm of the first optical interconnect.

56. The optoelectronic device structure of Claim 55, wherein the optoelectronic device provides for an optical switch.

57. The optoelectronic device of Claim 55, wherein the grating structures are chirped.

58. The optoelectronic device of Claim 55, wherein the optoelectronic device provides for a dispersion compensation filter.

59. The optoelectronic device of Claim 52, wherein the first optical interconnect comprises a port and grating structures formed on the port of the first optical interconnect.

60. The optoelectronic device of Claim 59, wherein the optoelectronic device provides for an optical circulator.

61. The optoelectronic device of Claim 52, wherein the first and second optical interconnects comprise arms and grating structures formed on the arms of the first and second optical interconnects.

62. The optoelectronic device of Claim 52, wherein the first and second optical interconnects are positioned in close proximity to one another to define a second coupling region which facilitates optical coupling between the first and second optical interconnects.

63. The optoelectronic device of Claim 62, wherein the first and second optical interconnects are positioned in a Mach-Zehnder interferometer configuration.

64. The optoelectronic device of Claim 62, wherein the first and second optical interconnects comprise grating structures disposed between the first coupling region and the second coupling region.

65. The optoelectronic device of Claim 64, wherein the grating structures of the first and second optical interconnects have a fixed periodicity.

66. The optoelectronic device of Claim 65, wherein the optoelectronic device provides for an add/drop filter.

67. A tunable laser device comprising:

a substrate having a first surface;

at least one optical interconnect formed on the first surface of the substrate comprising a sol-gel based material and including an active region and grating structures formed on the active region; and

at least one electrode plate proximate the active region of the interconnect,

wherein applying voltage to the at least one electrode plate alters the refractive index of the active region.

68. The tunable laser device of Claim 67, wherein the active region is doped with a rare earth ion.

69. The tunable laser device of Claim 67, wherein the active region is doped with one of the rare earth ions chosen from the group consisting of erbium, ytterbium, and neodymium.

70. The tunable laser device of Claim 67, wherein the active region is doped with erbium ions and ytterbium ions.

71. A tunable laser array system, comprising:

a substrate having a first surface;

a plurality of optical interconnects disposed in a predetermined pattern on the first surface of the substrate, each interconnect comprising a sol-gel based material and including an active region and a grating structures formed on the active region;

one or more electrodes, the one or more electrodes proximate the active region of the plurality of optical interconnects, and

at least one optical source in proximity to a respective active region that is used to pump the active region of the corresponding optical interconnect,

wherein applying voltage across the plurality of electrodes alters the refractive index of the active region.

72. The tunable laser array system of Claim 71, wherein the active region is doped with a rare earth ion.

73. The tunable laser array system of Claim 71, wherein the active region is doped with one of the rare earth ions chosen from the group consisting of erbium, ytterbium, and neodymium.

74. The tunable laser array system of Claim 71, wherein the active region is doped with erbium ions and ytterbium ions.

75. The tunable laser array system of Claim 71, wherein the at least one optical source comprises at least one vertical cavity surface emitting laser (VCSEL).

76. The tunable laser array system of Claim 71, wherein the at least one optical source comprises a sol-gel based material.

77. An optical dispersion compensation device, comprising:

a substrate having a first surface; and

an optical interconnect formed on the first surface of the substrate comprising a sol-gel based material and having chirped grating structures formed on the interconnect,

wherein the chirped grating structures serve as a selective delay line that delays wavelengths as they propagate through the optical interconnect.

78. An optical add/drop filter, comprising:

a substrate having a first surface; and

a first optical interconnect disposed on the first surface of the substrate comprising a sol-gel based material;

a second optical interconnect formed on the first surface of the substrate generally parallel to the first optical interconnect, the second optical interconnect comprising a sol-gel based material, wherein the first and second optical interconnects are positioned in close proximity to one another to define a first and second coupling region which facilitates optical coupling between the first and second optical interconnects; and

a plurality of fixed grating structures formed on the first and second optical interconnects between the first and second coupling regions.

79. An optical circulator, comprising:

a substrate having a first surface; and

a first optical interconnect disposed on the first surface of the substrate comprising a sol-gel based material;

a second optical interconnect formed on the first surface of the substrate generally parallel to the first optical interconnect, the second optical interconnect comprising a sol-gel based material;

a coupling region comprising an area in which the first and second optical interconnects come into close proximity to one another so as to facilitate optical coupling; and

a grating structure formed on an output port of the first optical interconnect,

wherein the grating structure filters a predetermined wavelength of light so that the predetermined wavelength of light is outputted through an output port of the second optical interconnect.

80. A multi-dimensional optoelectronic device, comprising:

a substrate having a first surface;

a first optical interconnect formed on the first surface of the substrate in a first horizontal plane of orientation relative to the first surface, the first optical interconnect comprising a sol-gel based material; and

a second optical interconnect formed in a second horizontal plane of orientation relative to the first surface, the second optical interconnect comprising a sol-gel based material.

81. The multi-dimensional optoelectronic device of Claim 80, further comprising a third optical interconnect formed in a third horizontal plane of orientation relative to the first surface, the third optical interconnect comprising a sol-gel based material.

82. A multi-dimensional optoelectronic coupler, comprising:

a substrate having a first surface;

a first optical interconnect disposed on the first surface of the substrate, the first optical interconnect comprising a sol-gel based material;

a second optical interconnect formed on the first surface of the substrate generally parallel to and disposed coplanar with the first optical interconnect, the second optical interconnect comprising a sol-gel based material;

a third optical interconnect formed in a plane of orientation displaced from the first and second optical interconnect, the third optical interconnect comprising a sol-gel based material;

a fourth optical interconnect formed in the same plane of orientation as the third optical interconnect generally parallel to the third optical interconnect, the fourth optical interconnect comprising a sol-gel based material; and

a first coupling region comprising an area in which the first, second, third and fourth optical interconnects come into close proximity to one another so as to facilitate optical coupling.

83. The multi-dimensional optoelectronic coupler of Claim 82, wherein the first, second, third and fourth optical interconnects are geometrically symmetric.

84. The multi-dimensional optoelectronic coupler of Claim 82, wherein the first, second, third and fourth optical interconnects are geometrically asymmetric.

85. A multi-dimensional optoelectronic device, comprising:

a substrate having a first surface;

a first optical interconnect disposed on the first surface of the substrate in a first horizontal plane of orientation relative to the first surface, the first optical interconnect comprising a sol-gel based material;

second, third and fourth optical interconnects formed in a second horizontal plane of orientation relative to the first surface and displaced from the first horizontal plane of orientation, wherein the second, third and fourth optical interconnects are generally parallel to each other and comprise a sol-gel based material; and

a fifth optical interconnect formed in a third horizontal plane of orientation relative to the first surface and displaced from the second plane of orientation, the fifth optical interconnect comprising a sol-gel based material,

wherein the first, third and fifth optical interconnects are formed in a first vertical plane of orientation relative to the first surface and the second and fourth optical interconnects are disposed in the second horizontal plane of orientation generally equidistant from opposite sides of the third optical interconnect.

86. The multi-dimensional optoelectronic device of Claim 85, wherein the first, second, third, fourth and fifth optical interconnects are positioned in close proximity to one another to define a first coupling region which facilitates optical coupling between the first, second, third, fourth and fifth optical interconnects.

87. A method for formulating a sol-gel based material used for optical interconnect formation, the method comprising:

pre-hydrolyzing a first monomer with an aqueous acid solution;

adding a second monomer to the first pre-hydrolyzed first monomer;

adding a coupling agent to the first and second monomers to form a sol-gel based polymer; and

aging the sol-gel based polymer to facilitate proper thickness,

wherein, post pre-hydrolyzation, the method for formulating a sol-gel based material is accomplished in a aqueous-free, alcohol free environment.

88. The method of Claim 87 wherein the first monomer comprises Methacryloxyproppyltrimethoxysilane (MAPTMS), the second monomer comprises methacrylic acid and the coupling agent comprises zirconium isopropoxide.

89. The method of Claim 88 wherein the first monomer comprises Methacryloxyproppyltrimethoxysilane (MAPTMS), the second monomer comprises methacrylic acid and the coupling agent comprises aluminum isopropoxide.

90. A method for fabricating a sol-gel based interconnect, the method comprising:

providing a substrate having a generally planar first surface;

disposing a first cladding layer comprised of a first sol-gel based material having a first refractive index on the first surface;

processing the first cladding layer at a temperature below the glass transition temperature of the sol-gel based material;

disposing a core layer comprised of a second sol-gel material having a second refractive index on the first cladding layer; and

processing the core layer at a temperature below the glass transition temperature of the first and second sol-gel based materials.

91. The method of Claim 90, further comprising disposing a second cladding layer comprised of a first sol-gel based material having a first refractive index on the core layer and the first cladding layer and processing the second cladding layer at a temperature below the glass transition temperature of the first and second sol-gel based materials.

92. The method of Claim 90, wherein processing the first cladding layer further comprises pre-baking, and post-baking the first cladding layer at temperatures below the glass transition temperature of the first sol-gel based material.

93. The method of Claim 90, wherein processing the core layer further comprises pre-baking, and post-baking the core layer at temperatures below the glass transition temperature of the first and second sol-gel based materials.

94. The method of Claim 91 wherein processing the second cladding layer further comprises pre-baking, and post-baking the second cladding layer at temperatures below the glass transition temperature of the first and second sol-gel based materials.

95. The method of Claim 91 wherein the first sol-gel based material has a lower refractive index than the second sol-gel based material.

96. A method for optically pumping an interconnect, the method comprising:

providing an optical interconnect comprising a sol-gel based material and formed on a planar surface of a substrate;

providing an optical source proximity a lengthwise side of the optical interconnect; and

pumping, optically, the lengthwise side of the optical interconnect with the optical source.